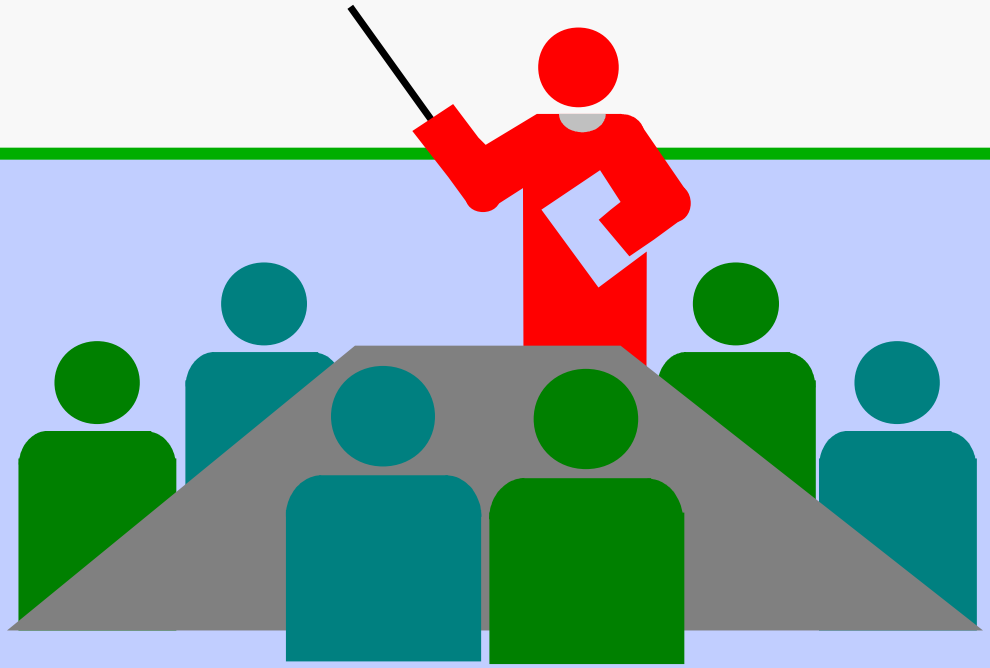
Describing the CMM and the CMMI



Objective:

- **Examine the SEI's Capability Maturity Model for Software**
- **Compare it to the Capability Maturity Model - Integrated**

The CMM: Capability Maturity Model for Software - Overview

- Focuses on practices that are under control of the software group
- Describes common sense, efficient, proven ways of doing business (which you should already be doing) - not a radical new approach
- Presents a minimum set of recommended practices that have been shown to enhance a software development and maintenance capability
  - It defines the expectation (the “what”)
  - Without overly constraining the implementation (the “how”)
- Used by Government and industry around the world to measure maturity of software development organizations
- Developed at the DoD-sponsored Software Engineering Institute (SEI)
  - Drafted in 1990; Version 1.1 dated 1993, to be retired in December 2003
  - Being replaced by the SEI’s CMM Integration (CMMI)

What is this CMMI?

- **What it is:** A process improvement model that provides a set of industry-recognized practices to address productivity, performance, costs and stakeholder satisfaction in the systems engineering and software development process.

- **How it is different:** The CMMI provides an integrated, consistent, enduring framework for enterprise-wide process improvement and can accommodate new initiatives as future needs are identified.

  Unlike single-discipline or stove-pipe models that can result in confusion and higher costs when implemented together.

- **Who it is for:** Those providing systems and software engineering products and services to organizations who transform customer needs expectations, and constraints into products, and supporting these products throughout their life.

Capability Maturity Model Integrated - Overview

- Multiple models, based on disciplines addressed
  - CMMI - SW: Software Engineering
  - CMMI - SE / SW: above plus Systems Engineering
  - CMMI - SE / SW / IPPD: above plus Integrated Product & Process Development
  - CMMI - SE / SW / IPPD / SS: above plus Supplier Sourcing
- Two representations
  - Staged: focus is on a Maturity Level by mastering sets of Process Areas that are grouped into 5 Maturity Levels (like SW-CMM)
  - Continuous: focus is on selected portions of Process Areas to achieve a Process Capability Level

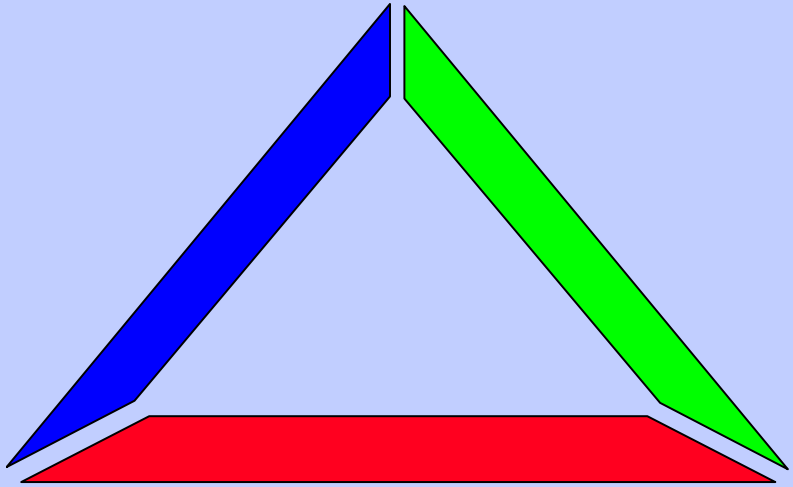
- Developed at the DoD-sponsored Software Engineering Institute (SEI)
  - Drafted in 1998; current versions dated 2002
  - Models and information at http://www.sei.cmu.edu/cmmi/

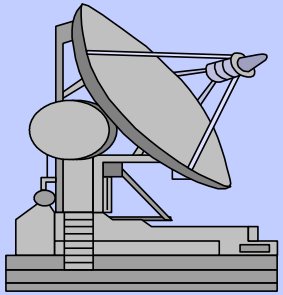
The Three Elements of Project Success

Process: a defined method involving steps or operations

People:

Skills, Training, Management





Technology:

Application domains, tools, languages, information, environments

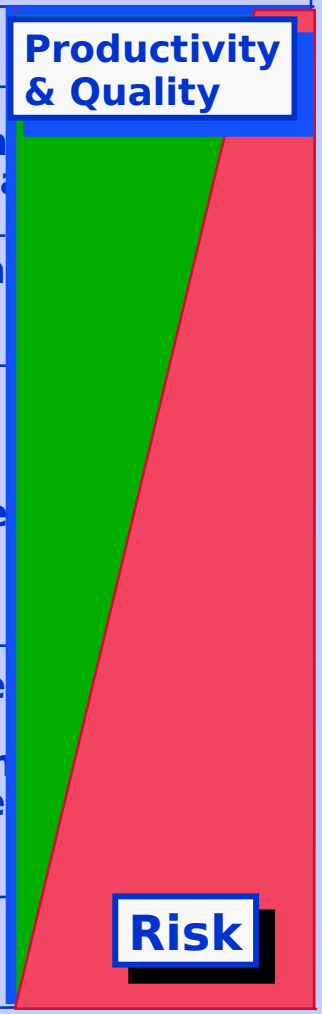
Improved Process + Competent Workforce + Appropriate Technology

=

Reduced Risk, Higher Productivity, and Better Quality

SEI Capability Maturity Model CMM

Level	Characteristic	Key Process Areas
Optimizing (5)	Continuous process capability improvement	Process change managem Technology change mana Defect prevention
Managed (4)	Product quality planning; tracking of measured software process	Software quality managem Quantitative process
Defined (3)	Software process defined and institutionalized to provide product quality control	Peer reviews Intergroup coordination Software product engineering Integrated software manageme Training program Organization process definition Organization process focus
Repeatable (2)	Management oversight and tracking project; stable planning and product baselines	Software configuration manage Software quality assurance Software subcontract managem Software project tracking & ove Software project planning Requirements management
Initial (1)	Ad hoc (success depends on heroes)	"People"

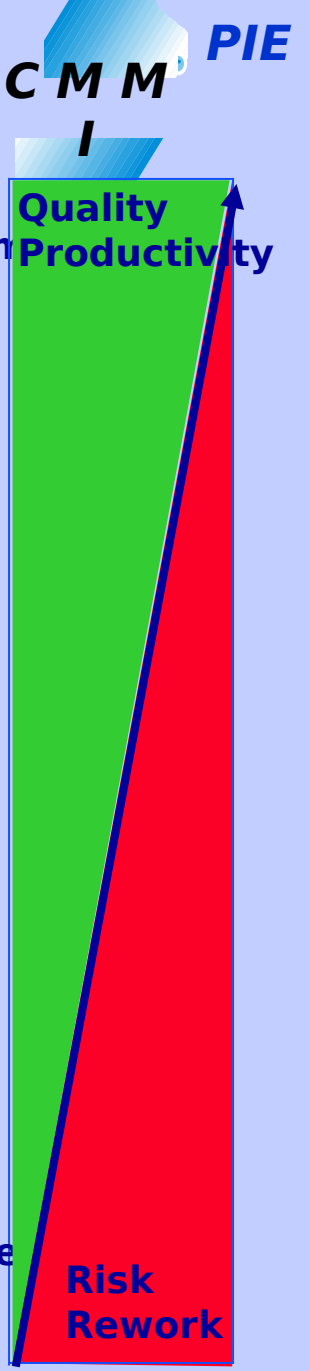


CMMI SE/SW/IPPD/SS Staged Representation

SPAWAR Systems Center San Diego

PIE

Level	Focus	Process Areas
5 Optimizing	*Continuous Process Improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative Management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process Standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Mgmt (with IPPD extras) Risk Management Decision Analysis and Resolution Integrated Teaming (IPPD only) Org. Environment for Integration (IPPD only) Integrated Supplier Management (SS only)
2 Managed	*Basic Project Management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		



Migrating from SW-CMM to the CMMI

	SW-CMM Key Process Areas	CMMI Process Areas (SE/SW)	
LEVEL 5 *OPTIMIZING*	Defect prevention Technology change mgmt Process change mgmt	Causal analysis and resoluti Org. innovation & deploymer	Focus still on continuous improvement
LEVEL 4 *MANAGED*	Quantitative process mgmt Software quality mgmt	Org. process performance Quantitative project mgmt	Focus still on quantitative management
LEVEL 3 *DEFINED*	Org. process focus Org. process definition Training program Integrated software mgmt Software product engr Intergroup coordination Peer reviews	Org. process focus Org. process definition Organizational training Integrated project mgmt Risk Management Technical solution Product Integration Verification Validation Requirements Development Decision Analysis / Resolution	Focus still on process standardizati on
LEVEL 2 *REPEAT-ABLE*	Requirements management Software project planning SW project track & oversight Software subcontract mgmt Software quality assurance Software configuration mgmt	Requirements management Project planning Project Monitoring & Control Measurement and Analysis Supplier agreement mgmt Product & Process QA Configuration mgmt	Focus still on basic project management

Level 1: the "Initial" Level
Success depends on heroes

Good performance is possible - but

- **Requirements often misunderstood, uncontrolled**
- **Schedules and budgets frequently missed**
- **Progress not measured**
- **Product content not tracked or controlled**
- **Engineering activities nonstandard, inconsistent**
- **Teams not coordinated, not trained**
- **Defects proliferate**

"Schedules run everything"

"Just send in the Tiger Team"

"Processes limit my creativity"

"Processes don't help my delivery schedule"

CMMI Level 2: the "Managed" Level - Establishing basic project management controls

CLARIFY REQUIREMENTS
- Baseline the product requirements

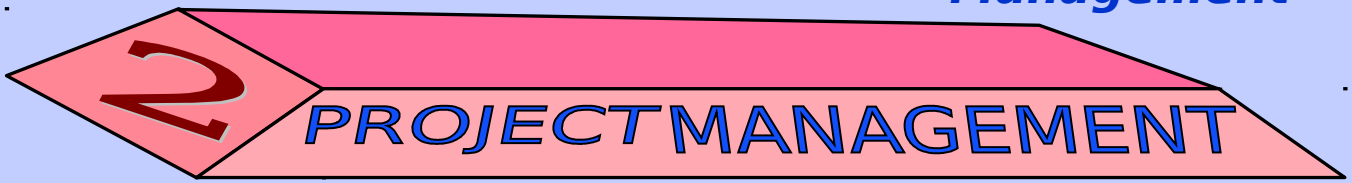
DOCUMENT PLANS
- Estimate project parameters,
- Develop plans and processes

TRACK PROGRESS
- Measure actual progress to enable timely corrective action
- Measure for mgmt. info needs
- Verify adherence of processes and products to requirements

CONTROL PRODUCTS
- Identify and control products, changes, problem reports
- Select qualified suppliers / vendors; manage their activities

7 Process Areas

- *Requirements Management (REQM)*
- *Project Planning (PP)*
- *Project Monitoring and Control (PMC)*
- *Measurement & Analysis (M&A)*
- *Process & Product Quality Assurance (PPQA)*
- *Configuration Management (CM)*
- *Supplier Agreement Management (SAM)*



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CMMI Level 3: the "Defined" Level - Standardizing the organization's process

ENGINEER THE PRODUCT

- Clarify customer requirements
- Solve design requirements; develop implementation processes
- Assemble product components, deliver
- Ensure products meet requirements
- Ensure products fulfill intended use
- Analyze decisions systematically

MANAGE THE PROCESSES

- Follow integrated, defined processes
- Identify and control potential problems

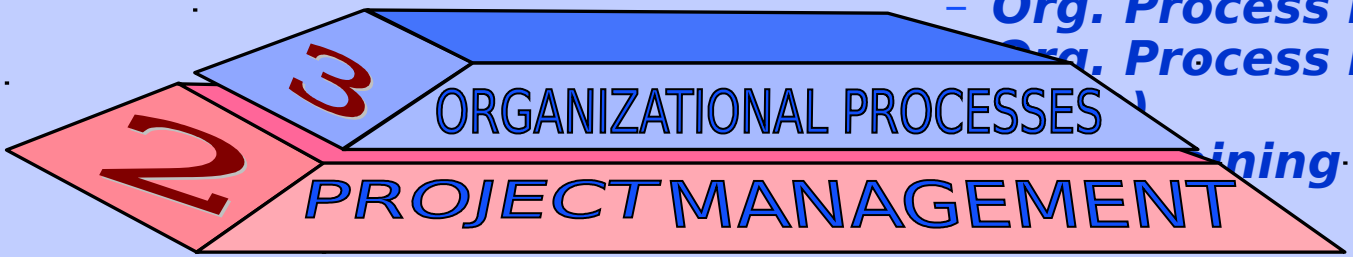
PROVIDE ORG. INFRASTRUCTURE

- Establish org. responsibility for P
- Define the org's best practices
- Develop skills and knowledge

*11 Process Areas**

- *Requirements Definition (RD)*
- *Technical Solution (TS)*
- *Product Integration (PI)*
- *Verification (Ver)*
- *Validation (Val)*
- *Decision Analysis & Resolution (DAR)*
- *Integrated Project Mgmt (IPM)*
- *Risk Management (RSKM)*
- *Org. Process Focus (OPF)*
- *Org. Process Definition*
- *ining (OT)*

*SE/SW model



CMMI Level 4: the "Quantitatively Managed" Level - Quantitative analysis of processes and products for monitoring and control

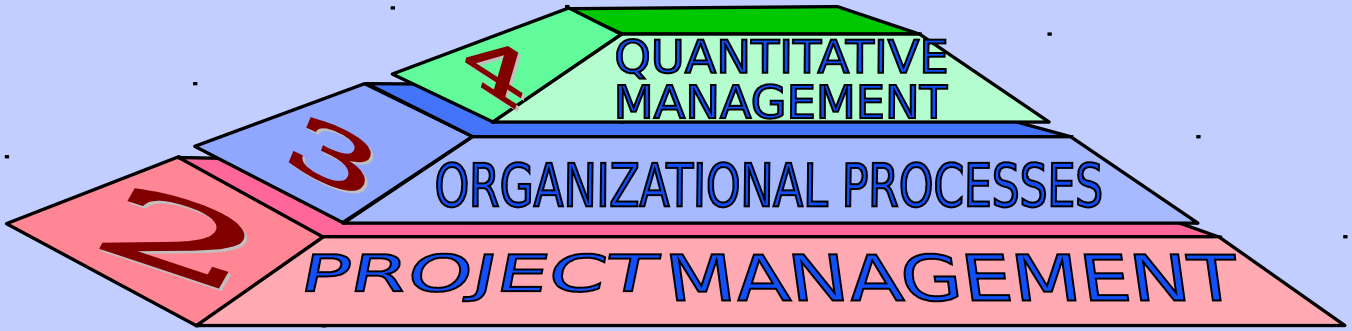
2 Process Areas

MANAGE PROJECTS QUANTITATIVELY

- **Statistically manage the project's processes and sub-processes** — ***Quantitative Project Management (QPM)***

MANAGE THE ORGANIZATION QUANTITATIVELY

- **Understand process performance; quantitatively manage the organization's projects** – ***Organizational Process Performance (OPP)***



CMMI Level 5: the "Optimizing" Level - Institutionalizing process improvement

2 Process Areas

OPTIMIZE PERFORMANCE

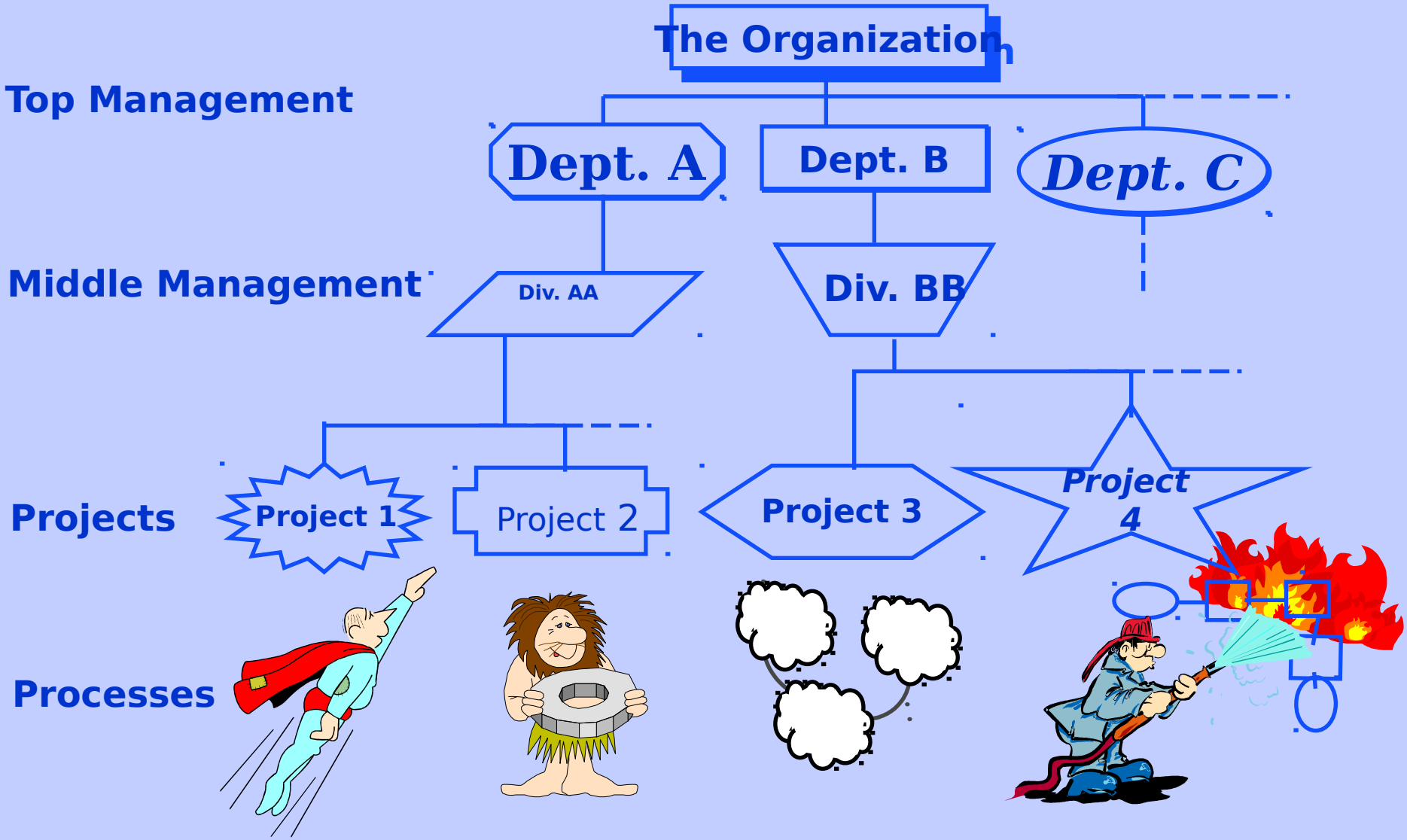
- **Identify and eliminate the cause of defects early** – ***Causal Analysis and Resolution (CAR)***

ADOPT IMPROVEMENTS

- **Identify and deploy new tools and process improvements to meet needs and business objectives** – ***Organizational Innovation and Deployment (OID)***

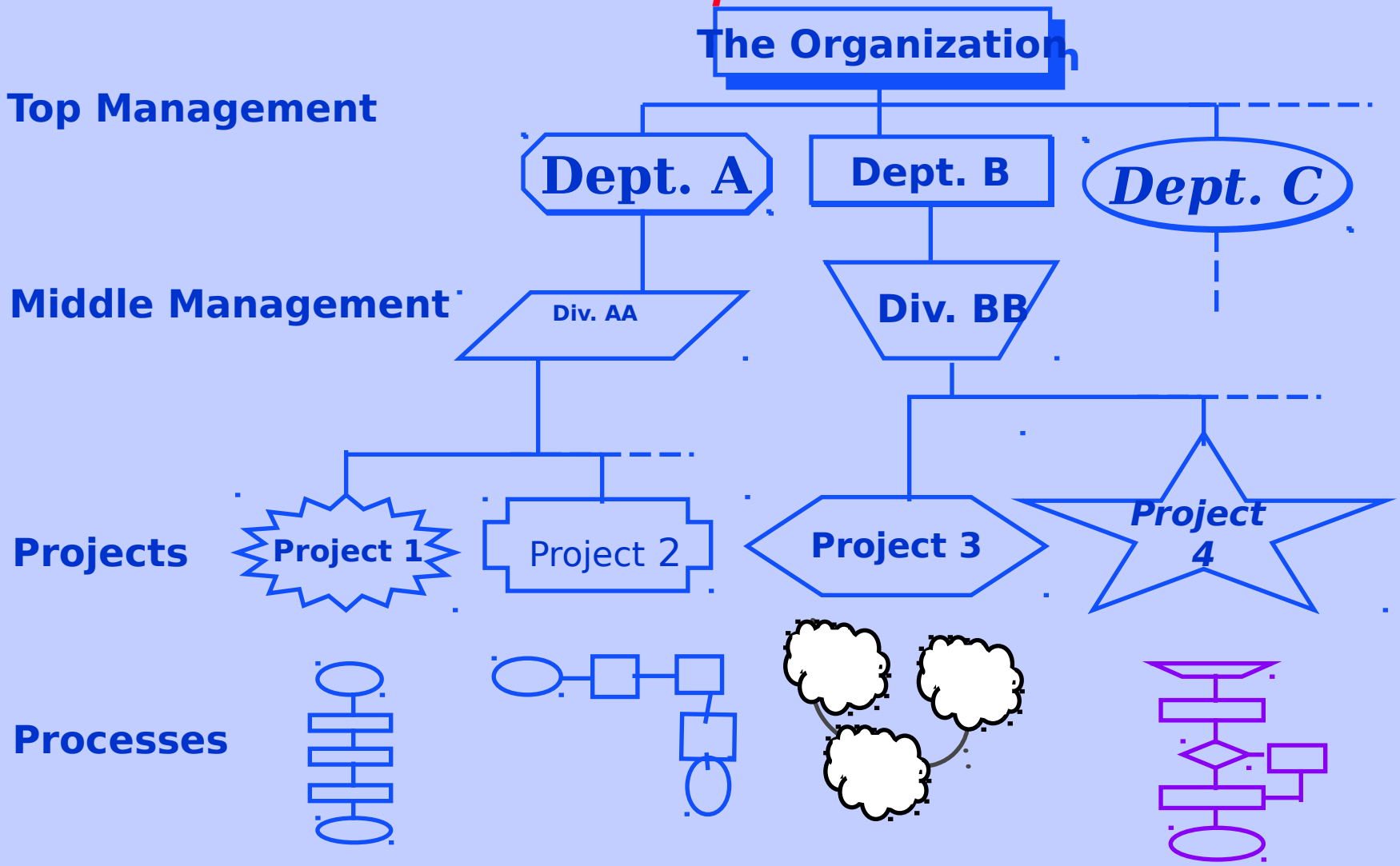
Sample Level 1 Organization

few processes in place



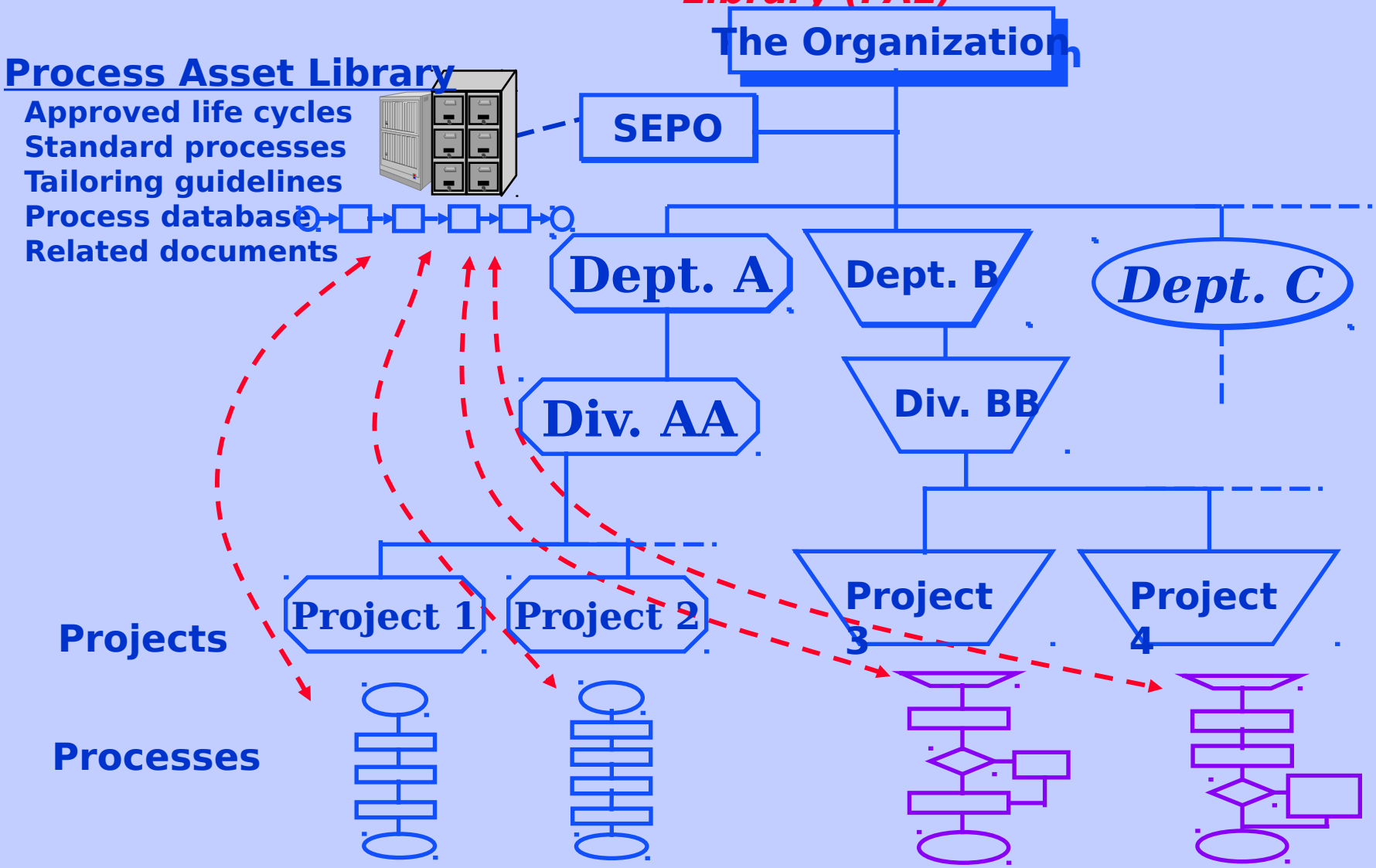
Sample Level 2 Organization

many processes in place; but they are project-specific



Sample Higher-Level Organization

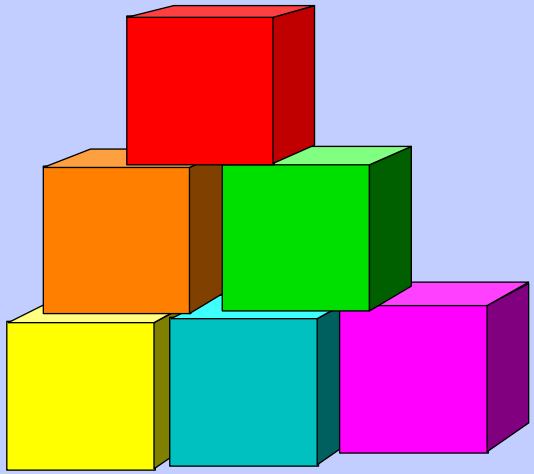
processes based on organization's Process Asset Library (PAL)



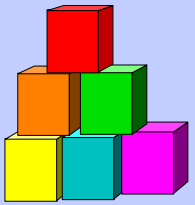
CMMI Process Area (PA) Structure

Each of the CMMI Process Areas (PAs) has:

- **Purpose Description**
- **Specific Goals (SG)**
- **Specific Practices (SP) for each goal**
- **Generic Goal (GG): Institutionalize a Managed Pro**
- **Generic Practices (GP)**
  1. **Establish an Organizational Policy**
  2. **Plan the Process**
  3. **Provide Resources**
  4. **Assign Responsibility**
  5. **Train People**
  6. **Manage Configurations**
  7. **Identify and Involve Relevant Stakeholders**
  8. **Monitor and Control the Process**
  9. **Objectively Evaluate Adherence**
  10. **Review Status with Higher-Level Manageme**



Example: Structure of the CMMI Project Planning PA



Purpose: Establish and maintain plans that define project activities

Goals	Practices
SG1 Estimates of project planning parameters are established and maintained	1.1 Estimate the scope of the project 1.2 Establish estimates of work product and task attributes 1.3 Define project life cycle 1.4 Determine estimates of effort and cost
SG2 A project plan is established and maintained	2.1 Establish the budget and schedule 2.2 Identify project risks 2.3 Plan for data management 2.4 Plan for project resources 2.5 Plan for needed knowledge and skills 2.6 Plan stakeholder involvement 2.7 Establish the Project Plan
SG3 Commitments to the plan are established	3.1 Review plans that affect the project 3.2 Reconcile work and resource levels 3.3 Obtain plan commitment
GG2 The process is institutionalized as a managed process	(see 10 generic practices)

How is a CMM Maturity Level determined?

The Software Capability Evaluation (SCE)

- **Description: A structured CMM-Based Appraisal in which a trained team examines an organization's current software practices. It consists of interviews, questionnaires, and analysis designed to identify the current process capability.**

- **Evaluators: A team of 4-6 SCE-trained people, external or internal to the organization**

- **Process: Typically one week of preparation off-site, then one week of on-site interviews and analysis, using the SCE process (see guidelines on SSC San Diego PAL)**

- **Results: Comprehensive verbal and written findings of strengths, weaknesses, and areas to improve. Can optionally result in a validated maturity level.**

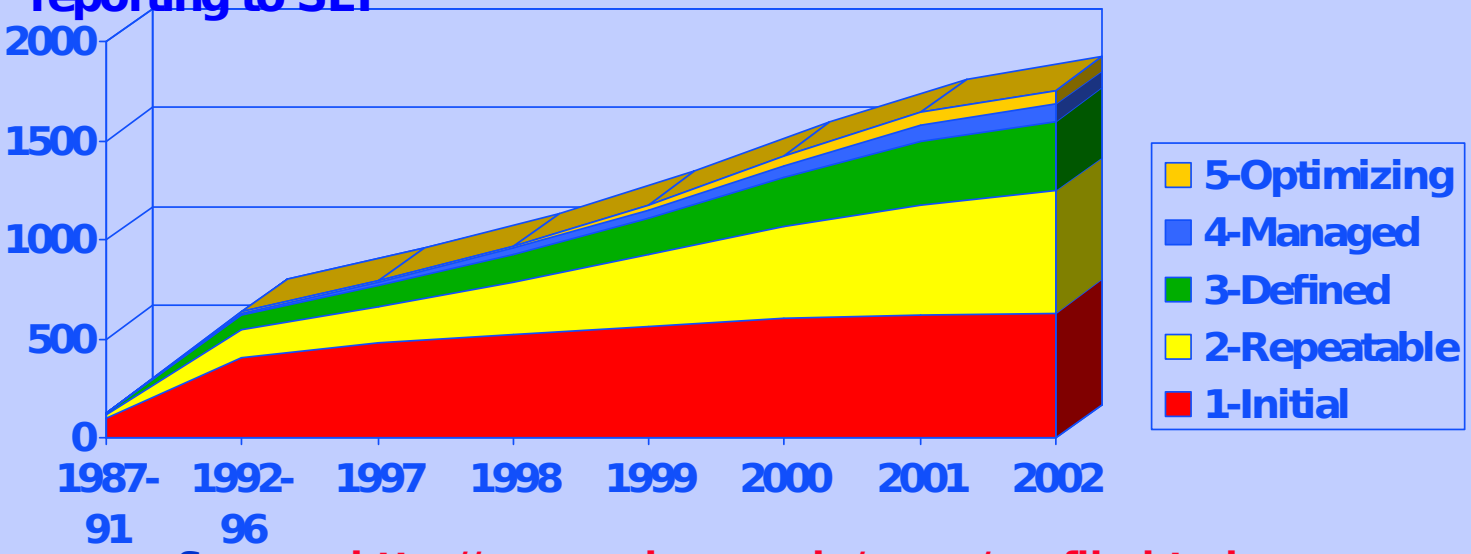
How is a CMMI Maturity Level determined?
The Standard CMMI Appraisal Method for Process Improvement (SCAMPI)

CMMI

- **Description: A structured appraisal in which a trained team examines an organization's current practices. It consists of interviews, questionnaires, and analysis designed to identify the current process capability.**
- **Evaluators: A team of 4-6 SCAMPI-trained people, external or internal to the organization**
- **Process: Typically one week of preparation off-site, then one week of on-site interviews and analysis**
- **Results: Comprehensive verbal and written findings of strengths, weaknesses, and areas to improve. Can optionally result in a validated maturity level**

CMM Process Maturity Profile of Software Community

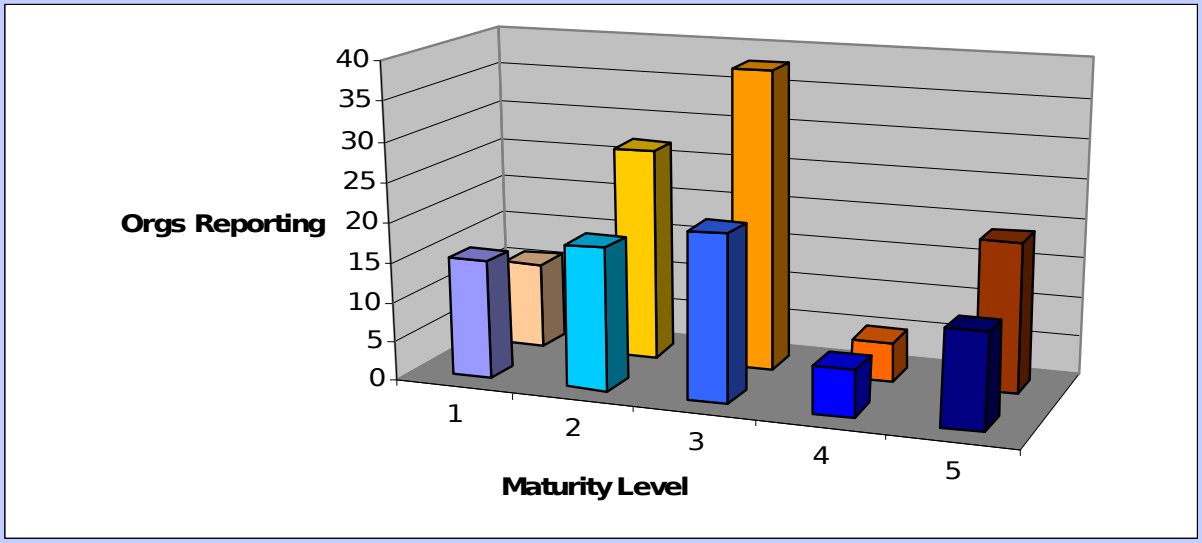
Maturity Level	1987-91	1997	1999	2001	December 2002
1- Initial	80%	61%	48%	38%	32%
2- Repeatable	12%	23%	30%	34%	37%
3- Defined	7%	14%	16%	20%	21%
4- Managed	0%	2%	4%	5%	5%
5- Optimizing	1%	1%	2%	4%	5%
Organizations reporting to SEI	130	795	1179	1641	1998



Source: http://www.sei.cmu.edu/sema/profile.html

CMMI Process Maturity Profile

Maturity Level	Feb 2003	Sept 2003
1- Initial	15%	11%
2- Managed	18%	27%
3- Defined	21%	38%
4- Quantitatively Managed	6%	5%
5- Optimizing	12%	19%
No rating assigned	27%	
Organizations reporting to SEI	33	100



Source: http://www.sei.cmu.edu/sema/profile.html

CMM and CMMI Advocates

Know Thy Competition: Organizations at CMM or CMMI Level 4

Boeing	CSC Defense Group	Honeywell
Hughes	Litton	Lockheed Martin
Motorola	NCR	Northrop Grumman
Raytheon	United Space Alliance	USAF Hill AFB
USAF Tinker AFB	USA CECOM	USN FMSO
NAWC China Lake	NSWC PHD (Dam Neck)	SAIC
BAE Rancho Bernardo	IBM	NASA Shuttle
	USA Fort Sill	

SW-CMM sources:

- CMM Softcopy: http://www.sei.cmu.edu/cmm/obtain.cmm.html
- Overview article: in SME Guidebook and at http://www.sei.cmu.edu/publications/documents/96.reports/96.ar.cmm.v1.1.html
- Power Point Overview: http://sepo.spawar.navy.mil/sepo/CMM_Overview.PPT
- Expert Mode: http://sepo.spawar.navy.mil/sepo/CMMExpert10.doc
- KPA Flow diagrams: http://sepo.spawar.navy.mil/sepo/CMMinfo.html

CMMI Sources:

- CMMI Softcopy: http://www.sei.cmu.edu/cmmi/models/models.html
- Transitioning to CMMI – A Guide for Executives http://www.sei.cmu.edu/cmmi/publications/exec.pdf

The CMM and CMMI: Summary

You should now know:

1. **Who developed the CMM and CMMI?**
2. **Which model(s) is/are SSC San Diego using?**
3. **What is the focus of Maturity Level 2?**
4. **What is the focus of Maturity Level 3?**
5. **How are Maturity Levels determined?**
6. **How is SSC San Diego's maturity compared to other organizations?**